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A. R. N. I. C. A.

MANAGEMENT OF NATURAL RESOURCES
THROUGH
AUTOMATIC CARTOGRAPHIC INVENTORY

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TYPE I PROGRESS REPORT
for Period August-September 1972
(n° 1)

(E72-10303) MANAGEMENT OF NATURAL
RESOURCES THROUGH AUTOMATIC CARTOGRAPHIC
INVENTORY P. Rey, et al (Centre
National de la Recherche Scientifique)
Nov. 1972 26 p

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ATTACHMENTS

- A. Plot of data
- B. List of receipt data
- C. Data comparison
- D. Descriptors

ABSTRACT

Objective of the Project.

ERTS.A RBV and MSS Imagery will be correlated with existing vegetation and geologic maps of southern FRANCE and northern SPAIN to develop correspondence codes between map units and space data.

Microclimate data from six stations, spectral measure from a few meters to 2 km using ERTS-type filters and also spectrometers, and leaf reflectance measurements will be obtained to assist in correlation studies.

Activity July-October 1972.

- . Receipt of the first data
 (August 1972) September 1972
- . Qualitative investigation of botanical and geological correlations.
- . Quantitative exploitation : densitometry.
- . Publishing of preprints.
- . The setting up of means of ground reflectance measurement and from the air.

The quality of the first data received and the first results of their study give every reason to believe that the whole programme will be carried out successfully.

MAJOR PROBLEMS

- The first data received concern the passages between August 16 and August 23 and that on September 21.
They only concern a part of the Test-site (see Attachment A) - (no doubt because of the cloud cover over southern France).
- The data received correspond in the main to those requested in the "PRODUCT ORDER FORM" (Dec. 20 1971)

M	MSS	4	5	6	7
T					7
P					7

However several sets of data are incomplete.
(see Attachment B)

- It would seem worthwhile, after the initial experiments of interpretation and of processing, that in the future, two copies of the following documents should be made available to us :

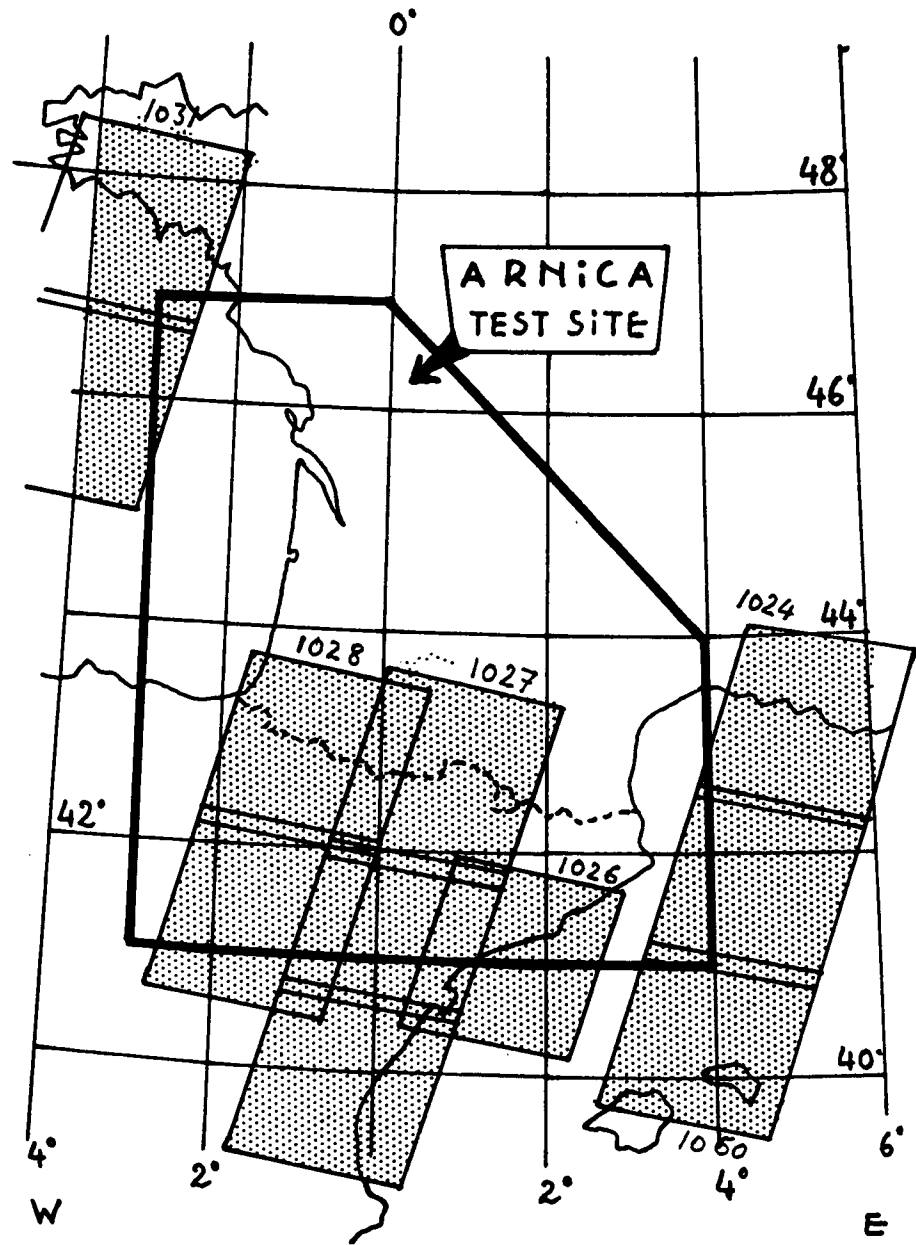
M	MSS	4	5	6	7
T	MSS		5		7
P	MSS		5		7

on account of the botanical and geological interest of the comparison of MSS 5 and 7.

(see Attachment C)

ATTACHMENT A

PLOT OF DATA
received on 30.11.72



ATTACHMENT B

LIST OF DATA received
on August-September 1972

	CPY	RBV	MSS	FMT
1024.09565	2		4567	M
	2		7	T
	2		7	P
1024.09572	2		4567	M
	2		7	T
	2		7	P
1026.10084	2		4567	M
	2		7	T
	2		7	P
1027.10135	2		4567	M
	2		7	T
* 1	1		7	P
1027.10141	2		4567	M
	2		7	T
	2		7	P
1027.10144	* 1		7	P
1028.10193	* 4		7	P
1028.10200	* 4		7	P
1031.10352	2		4567	M
	2		7	T
	2		7	P
1031.10355	2		4567	M
	2			T
	2			P
1060.09563	2		7	T
	2		7	P
1060.09572	1		456	M
	2		7	M
	2		7	T
	2		7	P
* no according to Product order form				

ATTACHMENT C

Comparison between :

- ✱ PI REQUESTED DATA
- NASA NOTIFIED DATA
- x NASA DELIVERED DATA

	Cpy	RBV	MSS	Cl	FMT
✱ ARNICA	1	123	7	8	M
Proposal	2	123	7		T
	2	123	7		P
● First listing	1	123	7	8	M
PI Information	2	123	7		T
system	2	123	7		P
✱ Product	2	123	4567	8	M
order form	2	123	7		T
12.23.71	2	123	7		P
● Standing	1	123	4567	8	M
order form	1	123	7		T
04.27.72	1	123	7		P
● Listing					
PI Information	1	123	4567	6	M
system	1	123	7		T
11.01.72					

x DELIVERED DATA
August-September 1972
cf. ATTACHMENT B

OPTIMAL DATA REQUEST

Cpy	RBV	MSS	Cl	FMT
2	123	4567	8	M
2	123	5 7	8	T
2	123	5 7	8	P

ACCOMPLISHMENTS DURING THE REPORTING PERIOD

A. Qualitative studies

- . Before receipt of the data :
 - Preparation of the cartographic data.
(see 6.1.1, 6.1.5)
 - Setting up of the procedures of analysis for the data.
(see 6.1.3, 6.1.6, 6.1.4)
- . After receipt of the data :
 - Filing and recording of data.
 - Study of the feasibility leading to the experimental checking of the correlation between the ERTS data and the geological and botanical maps.

B. Quantitative studies

- . Before receipt of the data :
 - Installation and technological test of the unit of numeration.
 - Development and application of software on Nimbus pictures and stratospheric balloons.
- . After receipt of the data :
 - Examination to determine the most remarkable sites of correlation between data and maps.
 - Densitometric exploitation of the chosen sites (botanical and geological).
 - Research on the automatic location of the sites.

C. Ground experiments

- Conception of a support system of repetitive measures of reflectance on the ground, adaptable to different types of vegetation cover.
- Choice of technical means and apparatus in harmony with those used on ERTS 1.

ACCOMPLISHMENTS PLANNED FOR NEXT PERIOD

A. Qualitative studies

- Catalog of the types of the data ERTS 1 which can be used.
- Coding and stocking on punched cards of this information.
- Research into the correspondance between data and ground (vegetation and geology) in the available part of the test-site.

B. Quantitative studies

- Densitometric exploitation of significant samples.
- Vegetation : research concerning the location of resinous vegetation in the Pyrenees and their densitometric correspondence.
 - . Cartographic test of ecological probability and the checking of this.
- Geology : research of signatures of lithological features of the sedimentary strata of Northern Spain and an attempt of cartographic completion.
 - . Research of geofractures.

C. Ground Experiments

- Carrying out of missions of qualitative testing on the ground on the days of the passage of the satellite (e.q. Dec. 5th).
- Construction of the apparatus for measuring the reflectance.
- Checking the photodiodes and the film used (from 2 to 18 m in height).

The apparatus will be operational for the first passages in January 1973.

DISCUSSION OF SIGNIFICANT RESULTS

The qualitative study of data brings out first significant results : not only they concern the ARNICA project itself, but also other disciplines for which the data are of great interest.

The main investigations concern the next disciplines (the underlined are specific to ARNICA project).

1. AGRICULTURE / FORESTRY

- B. Timber survey and classification
- F. Water utilization

2. LAND USE SURVEY and MAPPING

- A. Land use classification
- C. Thematic mapping
- E. Human population density
- H. General

3. GEOLOGICAL STRUCTURE and LANDFORM SURVEY

- I. Geomorphic and Landform survey
- J. Lithologic survey
- K. Structural survey

4. WATER RESOURCES

- D. Limnology
- G. Snow-survey
- H. Glacier survey
- K. River monitoring

5. MARINE RESOURCES

- F. Estuary dynamics

6. METEOROLOGY

- B. Air surface interactions

DISCUSSION OF SIGNIFICANT RESULTS

1. AGRICULTURE / FORESTRY

B. Timber survey and classification

(Data 1027.10135
and 1028.10193)

Within pyrenean forests, the comparison between the spectral signatures (MSS 5 - 7) offers possibility to discern

Beech (*Fagus sylvatica*)
Fir-tree (*Abies pectinata*)
Pines spp. (*Pinus uncinata*
Pinus silvestris)

(référence to Carte de la Végétation)

The densitometric correlation is very significant for Fir-tree.

(Data 1027.10141
MSS 5 and 7)

Within Ebre basin (Spain), it is possible to discern *Pinus silvestris* forests and *Pinus halepensis* forests. We are studying densitometry.

F. Water utilization

(Data 1027.10141
and 1028.10200)

- Identification (MSS 5) of irrigated crops ("regatiu") in Ebre valley and tributaries.
- Identification (MSS 7) of hydrography and large reservoirs ("pantanos").

DISCUSSION OF SIGNIFICANT RESULTS

2. LAND USE SURVEY AND MAPPING

A. Land use classification

The majority of the major types of Land use are visible on all the data, principally by comparison of MSS 5 and 7. The limits of the forest regions are particularly clear. It will be necessary to have data taken during each season to be able to establish a permanent classification of the landscape.

C. Thematic mapping

Three cases of correspondence ERTS data-maps should be envisaged.

- . In the areas where the vegetation map or the geologic map is available and precise (established in particular by photo-interpretation in French territory), the map enables the ERTS data to be read very clearly indeed and facilitates the organisation of research for the densitometric signatures of the principal kinds of forests.
- . In the areas where the map shows a good qualitative knowledge of the theme, but where the thematic limits are less precise (e. q. In Spanish territory, the absence of photo-interpretation), the comparison ERTS data-map enables the theme to be checked and more exact and more detailed cartographic limits to be drawn.
- . In the areas where the map has not yet been drawn up, the exploitation of the ERTS data enables the drawing up, at least, of a map of thematic probability and, perhaps, the possibility of looking forward to a real map in the near future at least for certain types of vegetation (resinous).

F. Human population density

On all the data MSS 7, the urban areas are clearly visible, especially :

PAU	TARBES	1028.10193	7
ZARAGOZA		1028.10200	7
LERIDA	BARCELONA	1026.10084	7

Most of the towns of moderate size can be identified.

DISCUSSION OF SIGNIFICANT RESULTS

3. GEOLOGICAL STRUCTURE AND LANDFORM SURVEY

I. Geomorphic and Landform surveys

(Data 1027.10135, 1027.10141
and 1028.10193)

The Drainage Pattern clearly appears in most data.

The high granite surfaces of the axis zone of the Pyrenees are clearly underlined by the presence of numerous glacial lakes.

The coastal lines are remarkable on all the data.

J. Lithologic surveys (all data)

There is very marked distinction between the principal sedimentation groups : Paleogenous limestone, Maestricht sandstone, Campanian limestone, Oligocenous and Miocenous from the basin of the Ebro.

K. Structural surveys

(Data 1028.10193 7)

- Folds in the zone of the Southern Pyrenees.
- Nappes, Thrust-faults and Klippe in the Gavar-nie region.

(Data 1027.10084 7)

- Graben in the Campo of Tarragona and the depression of Penedes.

(Data 1027.10141 7)

- Anticlinal reliefs on the Levant coast.

DISCUSSION OF SIGNIFICANT RESULTS

4. WATER RESOURCES

D. Limnology

(Data 1027.10135 7
1028.10193 7)

Possible complete listing of all the mountain lakes in the Pyrenees, of which the surface is superior to 1 ha. The ambiguity between signatures of "lake" and "shadow" is removed by comparing the MSS 7 and 5 or 4.

G. Snow surveys

(Data 1027.10135 7 5 4
1028.10193 7)

A slight snowfall at very high altitude (Sudden lower limit 2,300 m on the highest masses of the Pyrenees). The comparison of the same area on the data of Aug. 19 and Aug. 20 shows the conditions of the fusion of this short-lived snowfall.

H. Glacier surveys

(Same data that G.)

The small suspended glaciers of the Pyrenees have a very strong reflectance in all the spectral bands, especially MSS 4, where they can be easily distinguished from the slight layer of snow which fell on Aug. 18.

The glacier of the Vignemale gives a truly remarkable picture, as its orientation towards the S E reflects vertically the sun's rays.

K. River monitoring

(Data 1027.10141 4 5 6 7)

Comparison of the four data of the hydrographic system of the Ebro and of its main tributaries, by densitometric evaluation, leads to a very detailed interpretation of the conditions of transportation of alluvions, of sediment and of decantation of the fluvial waters, along the different rivers, towards the large reservoirs.

(See Type II Progress Report)

DISCUSSION
OF SIGNIFICANT RESULTS

5. MARINE RESOURCES

F. Estuary dynamics

(Data 1026.10084 4 5 6 7)

- . Particularly significant description of the structure of the "mouths of the Ebro", of the conditions of the forming of the Delta and of marine sedimentation, in the offing.
- . By an appropriate treatment of the data MSS 7 (revelation of the detail of the contrasts of grey in the marine part of the photograph) evidence is produced of the waves of sedimentation opposite the delta of the Ebro and at the mouth of the Llobregat (Barcelona).

NB. These documents, specially treated, have been entrusted, for more detailed study to Mr FONTANEL and GUY, PI of the programmes F0442 and F0404, and scientific correspondent for ARNICA.

DISCUSSION OF SIGNIFICANT RESULTS

6. METEOROLOGY

B. Air surfaces interactions

(Data 1027.10135 4 5 7)

This data of Aug. 19th 1972 illustrates a meteorologic situation which reveals perfectly the climate of the Pyrenees :

- . Fondamental opposition between the regions to the North of the mountains (the French plains : 80% of which is cloud covered), and the central regions (axis zone of the Pyrenees) and the south (Spanish sierras and the Ebro basin) which both have fine weather.
 - . The limit of the cloud cover follows closely the frontier ridges and the summits of the Northern face of the Pyrenees.
- Zones of warm influence, without clouds, are visible in all the limestone basins within the Pyrenees where the rainfall is always less.
- . A slight layer of snow was in evidence on the high summits above 2300 m in the axis zone.

This document is of exceptional interest, as it confirms in a remarkable way the whole range of ecological and biogeographic conditions in the Pyrenees.

LIST OF PAPERS

1. FLOUZAT, G., 1972. Conditions d'exploitation de la Carte de la Végétation (CNRS) pour le programme ARNICA. In "Recherches actuelles en télédétection et situation du programme ARNICA", rapport pour le CNES.
2. FLOUZAT, G., 1972. Les bases scientifiques et techniques du projet ARNICA B. In "Document du Service de la Carte de la Végétation", CNRS, Toulouse.
3. FLOUZAT, G., 1972. Introduction au traitement quantitatif des images de télédétection. In "Doc. SCV", CNRS, Toulouse.
4. FLOUZAT, G., 1972. Plan d'analyse des données de ERTS 1 pour le programme ARNICA. In "Doc. SCV", CNRS, Toulouse.
5. GOUAUX, P., 1972. Recherche des correspondances entre images de satellites et cartes de la végétation. In "Doc. SCV", CNRS, Toulouse.
6. MONCHANT, M., 1972. Traitements numériques de l'image en télédétection. In "Document du Centre d'Etude Spatiale des Rayonnements", Toulouse.
7. REY, P., ARLES, C., DELORME, R., 1972. Equidensités colorées et télédétection des ressources naturelles. In "Doc. SCV", CNRS, Toulouse.

RECOMMENDATIONS

- . The exploitation of the first data received confirms :
 - the great interest of the documentation thus collected.
 - the feasibility of the programme as initially defined.

- . The depth of the investigation and the improvement of the results will depend on the number of repetitive covers that it will be possible to obtain on the test-site.

For that reason, we would like to receive any data with up to 80% cloud cover, for, because of the great climatic contrasts existing on the test-site, the distribution of the data often has an ecological significance which could be exploited.

- . All the spectral bands seem to be of use, the most useful ones for the vegetation and geology being MSS 5 and MSS 7.

. COLOR COMPOSITE BULK REQUEST

Because of their great interest, we would like to receive in composite color Type C (MSS 4 - 5 - 7), the following data :

1027.10135
1027.10141
1028.10193

(see Data request form)

8 - 1

ERTS - IMAGE DESCRIPTOR

Cf. ATTACHMENT D

(4 sheets)

ATTACHMENT D

ERTS IMAGE DESCRIPTOR FORM

USER NAME REY, Paul AugustinDATE 11.25.72USER ID FO 433AGENCY CNRS Service Carte Végétation BP 4009 31 TOULOUSE FRANCE

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS *				DESCRIPTORS
	COAST	SEA	DELTA	GRABEN	
1024 09572 6	✓	✓			BAY-HEAD BEACH CAPE ISLAND PLAYA
1026 10084 4	✓	✓	✓	✓	ANTICLINAL MOUNTAIN COASTAL DUNE COASTAL PLAIN LITTORAL DRIFT PLAYA
1026 10084 5	✓	✓	✓	✓	AGRICULTURE ANTICLINAL MOUNTAIN CARTOGRAPHY COASTAL DUNE COASTAL PLAIN FOREST GEOLOGY LITTORAL DRIFT OCEANOGRAPHY VEGETATION
1026 10084 7	✓	✓	✓	✓	ANTICLINAL MOUNTAIN CARTOGRAPHY CITY COASTAL PLAIN CONIFER FAULT GEOLOGY HYDROLOGY HARBOR JETTY LITTORAL DRIFT MEANDER

ERTS IMAGE DESCRIPTOR FORM

USER NAME REY, Paul AugustinDATE 11.25.72USER ID FO 433AGENCY CNRS Service Carte Végétation BP 4009 31 TOULOUSE FRANCE

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS *				DESCRIPTORS
	SNOW	FOLD	LAKE	CONIFER	
1026 10084 7					UPBAN AREA VEGETATION
1027 10135 4	✓	✓			DENDRITIC DRAINAGE
1027 10135 5	✓	✓	✓	✓	CARTOGRAPHY CIRQUE DENDRITIC DRAINAGE DECIDUOUS FOREST GAP GEOGRAPHY GEOLOGY GLACIER METEOROLOGY MOUNTAIN OROGRAPHIC CLOUD PIEDMONT PLAIN VALLEY VEGETATION
1027 10135 7	✓	✓	✓	✓	METEOROLOGY OROGRAPHIC CLOUD PIEDMONT PLAIN VEGETATION

ERTS IMAGE DESCRIPTOR FORM

USER NAME REY, Paul AugustinDATE 11.25.72USER ID FO 433AGENCY CNRS Service Carte Végétation BP 4009 31 TOULOUSE FRANCE

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS *				DESCRIPTORS
	CONIFER	DELTA	LAKE	EROSION	
1027 10141 5	✓	✓	✓	✓	AGRICULTURE ALLUVIAL PLAIN ANTICLINAL MOUNTAIN BADLAND BARRENS BASIN AND RANGE BED BRUSH CARTOGRAPHY COASTAL PLAIN FOLD GEOGRAPHY GEOLOGY HYDROLOGY IRRIGATION RIVER SCRUB VEGETATION
1027 10141 7	✓	✓	✓	✓	ANTICLINAL MOUNTAIN CITY COASTAL PLAIN GEOLOGY HYDROLOGY MEANDER URBAN AREA VEGETATION

ERTS IMAGE DESCRIPTOR FORM

USER NAME REY, Paul AugustinDATE 11.25.72USER ID FO 433AGENCY CNRS Service Carte Végétation BP 4009 31 TOULOUSE FRANCE

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS *				DESCRIPTORS
	CITY	FOREST	LAKE	VALLEY	
1028 10193 7	✓	✓	✓	✓	ANTICLINE BADLAND BASIN AND RANGE CARTOGRAPHY COAST CONIFER DECIDUOUS DOME EROSION GAP GEOFRACTURE GEOGRAPHY GEOLOGY GLACIER KLIPPE LINEAMENT MEANDER MOUNTAIN NAPPE SNOW SYNCLINE THRUST FAULT URBAN AREA VEGETATION
1028 10200 7	✓	✓	✓	✓	AGRICULTURE ANTICLINORIUM BASIN AND RANGE BADLANDS CARTOGRAPHY CONIFER EROSION GEOLOGY HYDROLOGY VEGETATION